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A-pillar for a motor vehicle

The invention relates to an A-pillar for a motor vehicle according to the precharacterizing clause of claim 1.

Under the premise of high body stiffness and body strength increasingly greater demands are made of the vehicle body in terms of lightweight construction. The publications DE 100 15 325 A1 and WO 03 03 12 52 A1 propose body components, in particular A-pillars, which are composed of cast steel and are reinforced by different reinforcements or ribbed structures. Both proposed A-pillars have, however, a multiplicity of struts and ribs which serve for reinforcement purposes. However, in order to optimize the weight of the component, it is necessary to reduce the multiplicity of strut structures while retaining the strength and stiffness of the component. The object of the invention is to provide an A-pillar which has the same strength and stiffness as an A-pillar from the prior art and in this case comprises a lower weight.

The object is achieved in an A-pillar with the features of claim 1.

The A-pillar, according to claim 1, of a motor vehicle runs from a vehicle roof in the direction of a vehicle floor and in this case has a curved profile at least over one longitudinal section. The A-pillar has an essentially solid circumferential surface, in this case it is of essentially hollow configuration in its inner region.

The A-pillar according to claim 1 is distinguished in that, in its curved longitudinal section, it has a

reinforcement strut which in turn passes through a hollow cross section of the A-pillar. The reinforcement strut passes through the A-pillar from a rear wall region to a front wall region with respect to the vehicle. In this case, the reinforcement strut is configured in such a manner that it has an elliptical or a circular recess in an upper and lower boundary line - with respect to the motor vehicle. The radius of the ellipse or of the circle can change along the profile of the recess. The recess can thus assume a curved form.

The reinforcement strut according to claim 1 passes through the A-pillar in the region of its greatest curvature, to be precise from a rear region to a front region. This means, it passes through the A-pillar in the region in which the maximum loading occurs should the vehicle roll over. It is in this loading situation that the maximum forces act right in the curvature of the A-pillar and then act in particular on the front and the rear wall region. In this case, the wall region which is at the front with respect to the vehicle is loaded in tension, with the rear wall region being loaded in compression. The reinforcement strut therefore runs in a specific manner from a region severely loaded in tension to a region severely loaded in compression. Both high loading regions are connected by the reinforcement strut, as a result of which the A-pillar's buckling strength or deflection resistance is improved in a specific manner.

This profile of the reinforcement strut dissipates stresses which would otherwise have to be borne by a wall region of the A-pillar. By this means, the wall regions are relieved in turn from load, which leads to the A-pillar having higher strength and at the same time permits a saving on material and therefore a reduction in the weight of the wall regions of the A-pillar.

In addition, the reinforcement strut of the A-pillar according to claim 1 is distinguished in that it has an elliptical or circular recess in the upper and lower boundary line. These recesses have the effect that the stiffness of the A-pillar is raised continuously and homogeneously in the region of curvature which is reinforced by the strut. This avoids discontinuities in the stiffness. Discontinuities in the stiffness would lead, in the event of dynamic loading, to notch stresses in the reinforcement strut, which in turn could lead to the strut fracturing and to a sudden loss in stiffness and strength of the A-pillar. The recesses in the reinforcement strut are therefore optimized to the occurrence of sudden high dynamic stresses which occur in the case of the vehicle rolling over.

The height of the reinforcement strut, in each case as measured from its deepest recess, is advantageously at least 5 centimeters. The reinforcement strut generally has a maximum height in this case of 30 centimeters. In special loading situations, a higher height may also be expedient.

In a refinement of the invention, the A-pillar and the reinforcement strut are configured by an integrated cast steel component. In this case, the reinforcement strut is particularly firmly connected to the A-pillar, which is beneficial for the stiffness. In addition, a plurality of joining steps can be saved by the production of an integral component, thus reducing the production costs.

In particular by means of production in a casting process, it is possible to configure the wall regions of the A-pillar and of the reinforcement strut with a variable wall thickness. This enables the special loading situations to be entered into in a specific manner and therefore enables material to be reduced at

locations subjected to less loading, which in turn benefits the weight of the component.

In an advantageous refinement, the A-pillar runs in turn from a wall region of increased wall thickness to another wall region of increased wall thickness. These wall regions are in turn the wall regions which are subject in each case to the greatest tensile and compressive stress. As already explained, these wall regions are front and rear wall regions with respect to a vehicle. Accordingly, these wall regions, the front and rear wall regions, are therefore configured with an increased wall thickness. By contrast, lateral wall regions of the A-pillar can be produced in an appropriately thin manner.

The strut which passes through the A-pillar with the features of claim 1 brings about a significant reduction in the number of further struts with which an A-pillar is usually provided. In a refinement of the invention, depending on the loading situation, the entire A-pillar can just be provided with a single reinforcement strut.

Advantageous refinements of the invention are explained in more detail with reference to the following figures. In the figures:

fig. 1 shows a longitudinal section through a motor vehicle with an A-pillar and reinforcement strut,

fig. 2a shows a longitudinal section through an A-pillar with a reinforcement strut,

fig. 2b shows a cross section through the A-pillar from figure 2a along the section IIb,

fig. 2c shows a cross section through an A-pillar according to figure 2a along the section IIc,

fig. 3a shows a longitudinal section through an A-pillar with a reinforcement strut which has a variable cross section,

figs. 3b, c show examples of a cross section of a reinforcement strut through the section IIIb, IIIc from figure 3a,

fig. 4 shows a cross section through an A-pillar depicting the forces acting on the A-pillar,

figs. 5a, b, c show various types of A-pillars and their orientation with respect to the side edge and the sill region.

Figure 1 illustrates a basic arrangement of the claimed A-pillar in a typical vehicle. The motor vehicle 2, which is sectioned in figure 1 by its longitudinal center plane which, in turn, lies in the plane of projection, has a side edge 8, a sill 10 and a vehicle roof 3 and a vehicle floor 5. The A-pillar therefore runs from a vehicle roof 3 in the direction of a vehicle floor 5 and, in this example, ends with the sill 10. It has an essentially solid circumferential surface 17. For all of the further figures, a system of coordinates defined by figure 1 is applied for the purpose of better representation. According to the system of coordinates illustrated in figure 1, the transverse plane of the vehicle, in this case the plane of projection, is referred to as the XZ plane. According to this definition, the Y-axis points into the plane of projection, with the XY plane approximately corresponding to the carriageway.

Analogously to figure 1, figure 2a illustrates an A-pillar 4 without the vehicle. Figure 2a is a sectional

drawing through the A-pillar 4. It should be noted here that, in the section, the A-pillar is not entirely situated in the XZ plane; depending on the type of vehicle, the profile of the A-pillar also has a curvature in the Y-direction. The section of the A-pillar through the XZ plane, as illustrated in figure 2a, therefore merely constitutes a graphical simplification.

It should be pointed out at this point that the term A-pillar very generally comprises various regions of extension of this pillar. This may be defined by figures 5a to c. Figure 5a illustrates an A-pillar 4 which reaches from a vehicle roof (not illustrated here) as far as a side edge 8 (illustrated by a dashed line). The A-pillar 4 from figure 5b reaches from a vehicle roof beyond the side edge 8 and is connected there to the rest of the vehicle body by a connection (not illustrated). The term A-pillar can also be understood as meaning an A-pillar 4 according to figure 5c extending from a vehicle roof beyond the side edge 8 to the vehicle floor 5 or to the sill 10.

The A-pillar 4 from figure 2a has a reinforcement strut 6 which is arranged in the region of a curvature 15 of the A-pillar 4. The region of greatest curvature 15 frequently runs in the region of the side edge 8 or somewhat above it. In this case, as illustrated in the sections 2b and 2c, the reinforcement strut structure 6 runs approximately in the X-direction, with the precise profile of the reinforcement strut 6 being adapted with respect to the stress profile indicated in figure 4 by the loading situation F of the vehicle rolling over.

The reinforcement strut 6 essentially runs from a rear region 16 of the A-pillar with respect to the direction of travel (X direction) to a front region 18 of the A-pillar 4 with respect to the direction of travel. These wall regions 16, 18, on which also the greatest tensile

stress and compressive stress act, also have the greatest wall thickness of the A-pillar 4. In contrast to this, the outer or lateral wall regions 20 are configured to be relatively thin in the Y-direction. If appropriate, the wall regions 20 can even be of such thin configuration that the A-pillar no longer contains any material at all in this region, and accordingly is of open design.

A reinforcement strut 6 is illustrated, and with a dashed line 6′, in the YX cross section of figure 2c (hollow cross section 7), with it being possible for the cross section of the reinforcement strut 6, 6′ to taper or be thickened in accordance with the forces which occur and with respect to its Z-extent. The wall thickness of the reinforcement strut 6 or 6′ is expediently, for casting reasons, tapered in a central region (see line 6′) with respect to the YX plane along its longitudinal extent. This tapering 6′ leads to fewer stresses occurring during the casting of the A-pillar and during the cooling of the cast part.

Figure 2b illustrates the hollow cross section 7 along the YX plane IIb from figure 2a. The cross section IIb runs through the region of a recess 12 of the reinforcement strut 6 from figure 2a. In figure 2b, greater wall thicknesses can in turn be seen in the region 18 and 20, i.e. in the regions of high tensile and compressive stress. The lugs of the reinforcement struts 6 are already present but are interrupted by the recess 12.

Should these recesses 12 and 14 not be inserted, in a loading situation according to figure 4, which is characterized by the force F and is intended to simulate a vehicle rolling over, stress peaks 21 would occur which could lead to the reinforcement strut 6 fracturing. The recesses 12 and 14 minimize the stress peaks 21. In figure 4, the tensile stresses 24 which

occur in the loading situation and act on a front side of the A-pillar and compressive stresses 26 on a rear side of the A-pillar are furthermore illustrated diagrammatically. In principle, it is expedient for the entire profile of the A-pillar to have a higher wall thickness in the region of the tensile stresses 24 and the compressive stresses 26.

An alternative possibility for minimizing stress peaks is, analogously to figure 3, to design the reinforcement strut 6 to be thinner in an upper region and to let it become thicker in a central region and to be thinned again in a lower region. Figure 3a illustrates an A-pillar of this type which essentially corresponds to the one in figure 2a but does not have any recesses 12 and 14 which are present there. Instead, an A-pillar 4 of this type varying wall thickness along the section 3b, 3c which is situated in the YX plane. Examples of possible varying wall thicknesses are illustrated in figures 3b and 3c. Reinforcement struts 6 of this type each have their greatest thickness in the center. How they taper upward and downward depends on the load situation existing in each case. Of course, reinforcement struts 6 of this type according to figure 3 may also be provided with recesses (not illustrated here) in the upper and lower region.